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DISCONTINUOUS DISTRIBUTION AND SYSTEMATIC RELATIONSHIPS OF THE GENUS *OROTHRIPS* (THYSANOPTERA: AEOLOTHRIPIDAE) AND RELATED TAXA IN MEDITERRANEAN CLIMATES

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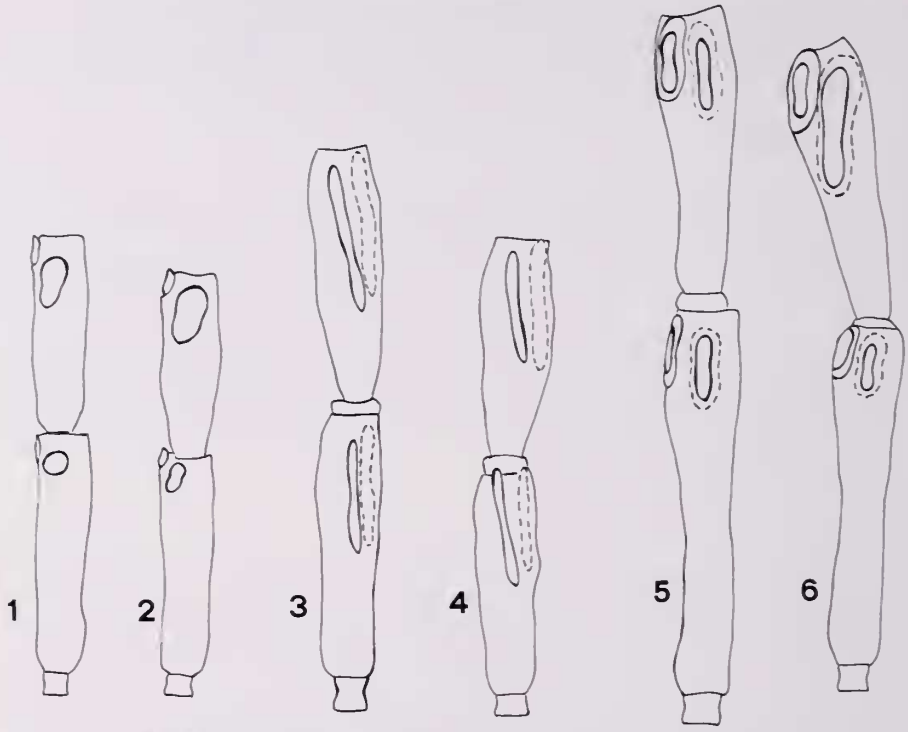
Abstract.—A key is provided to the three species of *Orothrips,* and two new synonyms are recognized. Two of these species are from western U.S.A. but the third is from southern Europe. This discontinuous distribution, also similar distribution patterns amongst other taxa in the basal clades of the Thysanoptera which involve the five areas of the world with a Mediterranean climate, is discussed. The systematic significance of the duplicated antennal sensoria found in *Orothrips* species is briefly discussed.

The genus *Orothrips* has been used for a group of large, flower infesting, banded-winged thrips which have two sensoria on each of antennal segments III and IV. Four species have been described from California and Oregon, and one species from India. In recent independent studies the authors concluded that the monobasic Mediterranean genus *Ekplectothrips* cannot be distinguished from *Orothrips.* Mound (1991) synonymized *Ecplectothrips* with *Orothrips* without further comment about the included species. Marullo (in press) compared the antennae and other morphological features of *Orothrips kelloggii* Moulton, *O. yosemitii* Moulton and *Ekplectothrips priesneri* Titschack, and concluded that they were congeneric. The purpose of this paper, therefore, is to re-examine the six nominal species, and to consider the systematic relationships of *Orothrips* and the geographic distribution of the included species. The members of this genus and those of several related genera appear to be associated largely with one or more of the five major areas in the world with a "Mediterranean" climate and vegetation.

OROTHRIPS MOULTON

Orothrips Moulton, 1907:45. Type-species *O. kelloggii* Moulton, by monotypy.
Ekplectothrips Titschack, 1958:4. Type-species *E. priesneri* Titschack, by monotypy. Synonymized by Mound, 1991:649.
Ecplectothrips Titschack, 1960:3. Invalid emendation.

Members of this genus are large dark-bodied Aeolothripinae, and share the following characters: Antennae 9-segmented, III and IV each with two sensoria. Head with no long setae; maxillary palps usually with more than three divisions. Pronotum with posteroangular setae no more than 1.5 times as long as discal setae; fore tarsus with a recurved claw and apposed seta. Mesopreepisternum not distinct; metanotal median setae near posterior margin. Forewing broad with transverse dark bands. Abdominal sternites with 4 pairs of marginal setae, but no discal setae.



Figs. 1–6. Antennal segments III and IV of *Orothrips* species. Female and male: 1–2, *O. yosemitii*; 3–4, *O. kelloggii*; 5–6, *O. priesneri*.

KEY TO SPECIES OF *OROTHRIPS*

1. Sensoria on antennal segment III strongly emergent, each produced into a broadly based sense cone (Figs. 1, 2) ..... *yosemitii*
– Sensoria on antennal segment III scarcely emergent, not produced into sense cones ... 2
2. Antennal segment III almost parallel sided, with sensoria slender, 4 to 10 times as long as wide (Figs. 3, 4) ..... *kelloggii*
– Antennal segment III club-shaped, distal third distinctly broader than basal two-thirds, sensoria broad, scarcely 1.5 times as long as wide (Figs. 5, 6) ..... *priesneri*

Orothrips kelloggii Moulton

Orothrips kelloggii Moulton, 1907:45.
Orothrips keeni Moulton, 1927:183. **NEW SYNONYMY**.

This species was described from nine males and six females collected in California, and it is now known from British Columbia, Oregon and Arizona (Bailey, 1957). It is found particularly in the flowers of *Arbutus*, *Arctostaphylus* and *Ceanothus*, and is sometimes taken with *O. yosemitii*. Bailey (1949) gives notes on its life history.

Moulton described *keeni* from a single small female from Oregon, which he distinguished by the "less deeply coloured" wing bands, and the sensory areas on the antennae being "distinctly shorter." Examination of more than 30 females of *kelloggii* from California and Oregon has indicated that an allometric relationship exists between the length of antennal segment III and the length of its longest sensory area. These two measurements are given here in microns for four females: the largest available female 135/55; the two smallest available females 93/36 and 90/16; the holotype female of *keeni* 84/20. The wing colour of the *keeni* holotype falls within the range of variation shown by material of *kelloggii*. Since *keeni* cannot be distinguished from *kelloggii* on any other characters it is here placed in synonymy. Males of *kelloggii* are smaller than females, but there are no significant differences in the antennal sensoria (Figs. 3, 4).

Orothrips yosemitii Moulton

Orothrips kelloggii yosemitii Moulton, 1911:34.
Orothrips yosemitei (sic) Moulton; Moulton, 1927:183.
Orothrips raoi Moulton, 1927:184. **NEW SYNONYMY**.
Orothrips variabilis Moulton, 1927:184.

This species was described from an unspecified number of syntypes collected in California. It is widespread and abundant in California, particularly on *Ceanothus* blossoms in spring, and is known from British Columbia, Washington, Oregon and Wyoming. Bailey (1949) recognized that *variabilis* represented the same species. Moreover, he was unable to find any characters to distinguish the holotype female of *raoi* from *yosemitii* satisfactorily. This specimen was apparently sent to Moulton from India with a sample of *Thrips florum,* according to his collections record card in the California Academy of Sciences. However, the species has never been collected again in India (Bhatti, 1991), and because the holotype cannot be distinguished from *yosemitii* females, it seems likely that it entered the Indian sample after this arrived in California. Moulton gave no characters to distinguish the species; he stated "Very similar to *yosemitei* and yet I cannot assign it to that species." Under these circumstances the species is here placed in synonymy. Males of *yosemitii* are slightly smaller than females, but have the sensoria on segment IV distinctly larger than those of females (Figs. 1, 2).

Orothrips priesneri (Titschack), **New Combination**

Ekplectothrips priesneri Titschack, 1958:5–10.

Although described originally from a single female collected in Spain, this species is widespread in the Mediterranean region from Spain to Turkey, and is common in southern Italy between March and May. Adults of both sexes have been taken in the flowers of a wide range of plants, particularly *Crataegus* and other Rosaceae. However, the larvae have not been collected and the true host-plant remains unknown. Females vary considerably in size, but the lengths of antennal segment III and its sensoria do not seem to have an allometric relationship, unlike *kelloggii*. The sensoria on segment IV of males are considerably larger than those of females (Figs. 5, 6).

SYSTEMATIC RELATIONSHIPS

The species of *Orothrips,* unlike almost all other Aeolothripidae, have two sensoria on both the third and the fourth antennal segments. This condition is otherwise found in this family only in the six species of *Dactuliothrips* and the single species of *Cycadothrips.* The remaining 240 or so species in the other 23 genera of Aeolothripidae all have only a single sensorium on each of these two antennal segments.

The phylogenetic significance of this apparent duplication of the antennal sensoria is difficult to assess, whether it is an apomorphy uniting the three genera or a symplesiomorphy derived from a common ancestor. The first seems inherently unlikely due to the very considerable differences between the three genera; *Dactuliothrips* species have long setae on the head and pronotum as in typical Melanthripinae; *Cycadothrips* has males unlike any other member of the family, and *Orothrips* species are otherwise similar to typical Aeolothripinae. The possibility that the sensoria represent a plesiomorphic condition must therefore be considered further.

The plesiomorphic structure of the sensoria on the third and fourth antennal segments of Terebrantia is presumably the circumpolar condition retained by the Merothripidae, the family which retains the largest number of plesiomorphies (Mound, Heming and Palmer, 1980). This condition is also found in the Heterothripidae, and the Melanthripinae of the Aeolothripidae, these groups also being amongst the least advanced Terebrantia. Some Aeolothripid species have the sensoria partially encircling the apex of each segment before extending basally (e.g., *Desmothrips*), although in *Aeolothrips* species the sensoria are usually shorter and linear. A further possible condition, with a circumpolar area extending basally as a pair of linear sensoria, is found in *Aulacothrips* and *Lenkothrips* of the Heterothripidae (see figs. in Mound *et al.,* 1980) and *Euceratothrips* of the Aeolothripidae. This may indicate the way in which twin sensoria evolved on antennal segments three and four, but the condition has been expressed rarely. It is not evidence that the three genera discussed here are closely related, although each may represent a basal branch within its own lineage. This is not the place for a phylogenetic analysis of aeolothripid genera. However, it seems possible that genera such as *Desmothrips* and *Stomatothrips,* which are currently placed in the Orothripini because they have subdivided maxillary palps (Priesner, 1949), are actually more closely related to *Aeolothrips* in the Aeolothripinae than they are to *Orothrips.*

GEOGRAPHIC RELATIONSHIPS

Most species of the insect order Thysanoptera live in the humid tropical and subtropical parts of the world, and the most plesiomorphic family, the Merothripidae, is restricted to such areas, as is the Uzelothripidae. The largest family, the Phlaeothripidae, is mainly tropical, although one genus, *Haplothrips,* has evolved many species in the flowers of various Asteraceae in temperate regions. The other large family, the Thripidae, is probably also mainly tropical, but is well represented in temperate regions with several genera restricted to such areas. The largest genus, *Thrips,* was considered to be primarily northern temperate until recently, but is now recognized to have many species in the Old World tropics although none in the Neotropics (Palmer, 1992). The other four families, all of which represent clades basal to the

Thripidae and Phlaeothripidae (Mound *et al.*, 1980), are relatively small, with restricted distributions.

The Heterothripidae includes about 50 species widespread in north and south America. In contrast, the Aeolothripidae includes more than 200 mostly holarctic species, with two genera predominating, *Aeolothrips* in the holarctic and *Melanthrips* in the paleartic. In this family, *Orothrips* now includes three species: two from western North America and one from the Mediterranean. This disjunct distribution is interesting because it is also found at generic level in the family Adiheterothripidae. This small family includes just two genera: *Oligothrips,* with a single species from California and Oregon, and *Holarthrothrips,* with several closely related species from the Mediterranean across to India, possibly associated with date palms. Furthermore, in the Aeolothripidae-Melanthripinae, the genus *Ankothrips* has 11 species, distributed as follows: seven between New Mexico and Washington State, two Mediterranean, two central Europe, and one from South Africa. Similarly, *Cranothrips,* which is scarcely separable from *Ankothrips,* has one species in South Africa and seven in Australia. Moreover, the genus *Dorythrips,* also a Melanthripine, has one species from Chile and two from Western Australia. Finally, the seventh recognized family, the Fauriellidae, includes three genera, two from South Africa and one from Spain, Turkey and Germany.

In contrast to the pantropical distributions of the two largest and most advanced families, the smaller families in the more basal clades, Fauriellidae, Adiheterothripidae and Aeolothripidae, have more restricted distributions. The taxa discussed here appear to be involved with the five areas of the world that have a "Mediterranean" climate of winter rainfall and hot summers; California, Chile, southern Australia, South Africa, and the Mediterranean. However, the floras of these five areas are not closely related to each other, and it is not possible to decide whether the thrips distributions are determined by ecological factors or represent some form of relict distribution.

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